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FOUNDRY TRADE JOURNAL
Established 1902
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Vol. 71 Thursday, October 21, 1943 No. 1418

## The Factory Report

The Chief Inspector, Mr. A. W. Garrett, has presented his third wartime report, which, to our mind, is a model for other civil servants. It is well balanced, and so well written that it never fails to retain the interest of the reader. Before the war, when extensive use could be made of tabular matter, we usually analysed the figures concerning the foundry industry and examined the letterpress for hints as to projected legislation. Now this is all changed for the unfolding of what is happening expressed in general terms. As would be expected the accidents to female operatives has risen (by 66 per cent. over 1941), but the figure is not alarming when cognisance is taken of the increasing part that women are taking in the heavy industries. Some of the older operatives are being injured at a higher rate because "they are not always willing to admit they have in some ways lost their sprightliness." Another cause of increased accidents is due to the cutting down of the maintenance staff, and in this direction the chief inspector issues a warning against this being overdone.

War conditions are also responsible for placing many accidents into the "Reportable" class, because a minor hurt is made the excuse for staying away more than three days. When operatives are "off colour," they are more liable to accidents, and this fact underlines the need for more adequate medical supervision. There are several references to the foundry industry. The first one is laudatory, and commends a firm making steel castings for reducing its accidents from 91 in 1941 with 472 operatives to 48 in 1942 with 419. The second one is also satisfactory, and is worth emulation. It refers to the excellent results consequential upon a visit to the Industrial Museum in Horseferry Road in 1936 by the managing director of a foundry. Since that date there has not been a serious eye accident, and other accidents have been decidedly reduced. During the year, a new regulation known as the Magnesium (Grinding of Castings and other articles) was issued with a view to reducing the fire hazards. Of grave concern to the industry is the work now in hand concerning the risk of silicosis in steel foundries through the rapid expansion of the steel castings production due to the war and the pressure on the men concerned. "Here the risk is apparent," says the Report, "and the difficulty is the technical one of suggesting practical methods by which it can be overcome without interruption of the war effort." After conferences with both sides of the industry a committee under the chairmanship of a Deputy Chief Inspector was set up consisting of representatives of employers, trade unions, a university technical expert with inspectors, including engineering and medical, who have special knowledge of the trade. In connection with the heating of shops, the Report condemns the use of coke braziers, and comments: "This is a method of heating that is in effect illegal except possibly in certain large shops and is a positive menace to life in many cases." Verb sap! There is a complaint registered against unintelligent attempts at ventilation, the worst being the case of a works manager who thought that no means of ventilation was necessary because the shop was new! Others relate to the existence of short circuits between intake and exhaust.

In general, the Chief Inspector seems satisfied with the progress made in the provision and utilisation of canteen and washing facilities, though the problem of the smaller works still exists, and will be difficult of solution. Foundrymen in general admire the work of Factory Inspectorate, and will support any efforts that can be made in the post-war era to spread its dictates internationally so that these humanitarian efforts will not act against British goods in the export market.

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## INSTITUTE CALENDAR

### MEETINGS FOR OCTOBER AND NOVEMBER 1943

October 23—*Bristol Branch.*—" Production Problems in General Engineering Castings," by F. Jackson. At Gloucester, at 3 p.m.

October 23—*East Midlands Branch.*—" Radiography as an Aid to Foundry Technique," by W. Gladwell. At Loughborough College, at 3 p.m.

October 23—*London Branch.*—"At Atlas of Defects in Non-Ferrous Castings." Non-Ferrous Sub-Committee Report, presented by Mr. A. Logan.

October 30—*Birmingham Branch.*—" The Feeding of Non-Ferrous Castings," by W. Baker. At the James Watt Institute, Great Charles Street, Birmingham.

October 30—*Lincoln Section.*—" Running and Risering in Relation to Defective Castings," by E. W. Harding. Accompanied by a film on " Gating."

November 6—*Wales and Monmouth Branch.*—" Foundry Technique in Relation to Certain Pressure Castings," by F. Dunleavy.

November 13—*Lancashire Branch*—" The Use of the Syphon Brick Method of Cupola Tapping," by E. R. Dunning. At the Engineers' Club, Albert Square, Manchester, at 3 p.m.

November 13—*Lincoln Section.*—" Radiography as an Aid to Foundry Technique," by W. Gladwell.

November 13—*Scottish Branch.*—" An Atlas of Defects in Non-Ferrous Castings." Non-Ferrous Sub-Committee Report, presented by Mr. J. Arnott. At the Royal Technical College, George Street, Glasgow, at 3 p.m.

November 13—*West Riding of Yorkshire Branch.*—Works Visit to W. C. Holmes & Company, Limited, Huddersfield, at 3 p.m.

November 20—*Bristol Branch.*—" Risering and Gating on Meehanite Castings," by G. Hobman. At the Merchant Venturers' Technical College, Bristol, at 3 p.m.

November 20—*East Midlands Branch.*—Industry and Education," by G. L. Harbach and J. R. Horton. At the College of Technology, Leicester, at 3 p.m.

November 20—*London Branch.*—" Magnesium Foundry Practice," by I. F. Ross. At the National Liberal Club, London, W.C.2.

November 24—*London Branch.* — " Magnesium Foundry Practice," by I. F. Ross. At Slough.

November 27—*Birmingham Branch.*—"An Atlas of Defects in Non-Ferrous Castings." Non-Ferrous Sub-Committee Report, presented by Mr. F. Hudson. At the James Watt Institute, Great Charles Street, Birmingham.

#### 1944 Conference Papers

The Publications Committee of the Institute of British Foundrymen invites Members to submit papers on technical subjects for potential presentation at the 1944 Annual General Meeting of the Institute, to the acting secretary (Mr. John Bolton), St. John Street Chambers, Deansgate, Manchester, 3, before January 30, 1943, advising him of their intention to do so as soon as possible, preferably with the addition of proposed title of paper.

## NOTES FROM THE BRANCHES

*East Midlands* — The Branch opened the 1943-44 session with a visit to the mechanised steel foundry of the Butterley Company. The visitors, numbering more than a hundred, were welcomed by Mr. J. W. Gardom, vice-president of the Institute, on behalf of the management. As the plant had been previously described and illustrated to the members, this added considerably to the interest aroused, especially as the guides had been carefully chosen for their full knowledge of the plant and processes. After tea had been served, the thanks for the Branch were expressed by Mr. G. L. Harbach, the retiring president, and Mr. Orme, vice-president. Mr. FitzHerbert Wright responded on behalf of the company.

At a meeting which followed, Mr. Harbach inducted Mr. W. H. Smith into the chair. In the course of a short Presidential Address he referred to the activities of the Education Committee of the Institute and the intelligent manner in which it was tackling the problems of post-war conditions. He also paid a tribute to the work of the various technical committees, commenting that " ideas have been pooled and improved knowledge on countless subjects is available on a scale hitherto unknown." Finally he reviewed the programme established for the current session.

The meeting concluded with the re-presentation by Mr. L. W. Bolton and Mr. J. Hill of their joint Paper on " The Continuous Production of Manganese Steel Castings."

## GERMAN " DIN " STANDARDS

The official movement to set up national standards comparable to the specifications of the British Standards Institution was instituted in Germany in 1917. Although prior to that date standards had, for some years, been adopted in various branches of industry, mainly under the aegis of trade associations, no co-ordination on a national basis covering the whole of industry and engineering had been made by the end of 1916. In the following year a national institution, Deutsche Normenausschuss, was formed, mainly to standardise materials and equipment supplied to the German armed forces. Since that time, the German Standards Committee has continued to function and expand. A survey of its activities and development over the last 25 years are given in an article by W. HELLMICH in " Stahl und Eisen " of November 5 last. The survey is of a general nature and does not particularise. It appears that about 7,700 standard specifications have now been issued in Germany, of which 1,160 deal with fundamental standards and associated subjects, 620 with building, 420 with mining, 790 with railway technique, 570 with electrical engineering, 600 with power-driven vehicles, 930 with machinery and machine construction, 400 with tools and machine tools, and 1,480 with shipbuilding.

SAVE STILL MORE PAPER

# MEETING THE RAW MATERIALS SUPPLY POSITION IN GREY IRON FOUNDRIES

*Discussion of Report at Institute's Annual Meeting*

## A REPORT BY THE CAST IRON SUB-COMMITTEE OF THE TECHNICAL COMMITTEE OF THE INSTITUTE OF BRITISH FOUNDRYMEN

This Report was presented to the Annual Conference of the Institute of British Foundrymen by Mr. P. A. Russell, B.Sc. (Convener of the Sub-Committee), on behalf of the Cast Iron Sub-Committee of the Technical Committee of the Institute. Dr. A. B. Everest (hon. secretary of the Sub-Committee) accompanied Mr. Russell.

MR. RUSSELL commented that the Report was not prepared as a Conference Paper. The members of the Sub-Committee had felt that, inasmuch as the problem of the supply of raw materials had been a difficult one, they might with advantage prepare the Report on the basis of their personal experiences so that individual foundrymen would know what others in the industry were doing. It might be, of course, that on the whole the industry had done better than the Sub-Committee knew.

MR. H. H. SHEPHERD, who opened the discussion, congratulated the Sub-Committee upon its very concise and valuable Report. After asking for information as to the cost of the Schofield pyrometer, he quoted the last sentence of the section of the Report headed "Use of Denseners," that "the least that one must do is to avoid the direct impingement of the metal entering the mould on to the metal densener," and emphasised its particular importance to the grey iron and the malleable-iron founders.

Discussing the modern practice of making late silicon additions and the reference made in the Report to the introduction of ferro-silicon in powdered form, he asked whether the Sub-Committee favoured the use of, say, 75 per cent. ferro-silicon. His final point at this stage was that the Sub-Committee had omitted to mention the improvement effected in the machinability of castings by making late silicon additions. He used late silicon additions very largely with a view to adding machinability, and the benefits derived in that direction were remarkable.

### The Phosphorus Bogey

MR. F. J. COOK (Past-President), whilst expressing his appreciation of the Report, said he was surprised that the old bogey of phosphorus content should still arise. Provided the total-carbon/silicon ratio was correct, phosphorus could be used to the extent of at least 1 per cent. in irons for making cylinders of, say, from ¾-in. to 1¼-in. thickness, and it would not give rise to porosity. The reason that the phosphorus content of cylinder irons had been reduced to a low figure was that otherwise automobile cylinders were so thin that the founder could not achieve the total-carbon/silicon ratio necessary to produce a reasonably soft casting. Hence the necessity for low phosphorus in this class of work.

MR. J. BLAKISTON, referring to late silicon additions, said that the Sub-Committee had specified the addition of ferro-silicon in powdered form, which was the most wasteful form. It should be added either in the pea size or the walnut size. Late silicon additions definitely improved a phosphoric iron casting and reduced the tendency to draw. Complimenting the Sub-Committee on having drawn attention to the use of "shrink bobs" in general casting production, he said they did overcome shrinkage difficulties in many cases, and it was surprising that very many foundrymen never dreamed of resorting to their use in order to overcome their difficulties.

The only method mentioned in the Report to which he took strong exception was the suggested method of manufacture of a cast-iron coupling in phosphoric iron. One of the most important machining surfaces on that coupling was cast "up over," which was all wrong; the result of the proposed method of casting was to form a trap for the gases, so that as they were generated they would have to vent down. It was well known that pre-venting was one of the secrets of obtaining soundness in cast-iron components, particularly in the shoulders. In the Black Country the coupling in question was being cast successfully from a phosphoric iron. It was moulded with the flange "down over," the set-up being very simple; the runner came straight down and entered the side of the coupling tangentially, there being no risers or feeding heads. The whole secret of success was to achieve the right casting temperature.

A pencil-type runner was used, and the metal passed through a small ring core, the holes being of needle size. The casting temperature was controlled at a very high figure, and the size of the holes was such that the time occupied in filling the mould was approximately 1½ min. He believed that 99 per cent. of the castings were produced, without any trace of porosity or draw, in phosphoric iron.

Recalling Mr. Cook's comments on the phosphorus bogey, he said that with the introduction of low-phosphorus iron the general engineering industry had experienced excessive wear in iron castings. High-phosphorus irons, on the other hand, gave exceptionally good wearing properties. Some of the old machine tools, which were still running, after 70 years' service, had practically the same clearances in the bearings as when they were first constructed; invariably the castings were made in high-phosphorus iron. Those castings had a very open appearance, but they displayed

## Supplies for Grey Iron Foundries

the characteristic of good wear resistance, which was peculiar to phosphoric iron.

Finally, he said that the best cast iron which would stand up to the latest developments in tungsten carbide forming and diamond cutting was one containing 1.8 per cent. phosphorus. This mixture was found to be superior to any alloy iron for the cutting and lapping of these extremely hard materials.

MR. W. G. THORNTON, who said that his experience concerning the casting of the coupling referred to in the Report was exactly similar to that of Mr. Blakiston, asked the Sub-Committee for information as to the life of denseners.

### Impact on Increased Man-hours

MR. G. W. ROUSHAM drew attention to the reference in the Report to the silicon/carbon balance, and asked if the Sub-Committee could publish it in tabular form. Bearing in mind that, in addition to supply difficulties, there was also the problem of labour shortage, he said it seemed, from a consideration of the Sub-Committee's findings generally, that the use of high-phosphorus iron was a compromise rather than a definite solution of the raw materials problem. For making such things as bombs, and so on, it was obviously useful to experiment with a view to using as far as possible the materials indigenous to this country. But surely labour was just as scarce as materials, and he suggested that it would be advisable to allow jobbing founders to have certain materials other than the compromise materials, to enable them to avoid scrap and thus achieve economy in labour.

Commenting that the Sub-Committee appeared rather to deprecate the manufacture of refined pig-iron by a foundryman for his own use, Mr. Rousham said the manufacturers of cupola-melted refined iron for sale used their hematite presumably with the idea that, say, 50 tons of hematite iron would produce 100 tons of low-phosphorus pig-iron. But the foundryman could produce, with 50 tons of hematite iron, 100 tons or more of castings, and it seemed to him that that might be a more economical use of hematite iron.

### Phosphorus in American Irons

MR. SHEPHERD, discussing phosphorus content, suggested that the objections to high-phosphorus cast irons might be conditioned to some extent by the fact that phosphorus, which was present in indigenous irons, was cheap, and because it was cheap we did not want it. It was that sort of mental process which led some men to drink whisky instead of water, because water was cheap! Until a few years ago the Americans had been scared by high-phosphorus iron. There were very few high-phosphorus irons in their country, their highest phosphorus content being in the region of 0.8 per cent., and they had had no experience of any higher phosphorus content. As a result, they had developed their metallurgical technique along the lines of medium- and low-phosphorus irons.

He had taken part in some very heated discussions on the matter when in the United States. Imagine his surprise, therefore, when he saw an article published in one of the American house journals—which he had kept because it constituted documentary evidence! In this McKenzie had assured his readers that he would publish a whole series of further articles to prove that higher phosphorus contents were of value in iron castings and that the opposite school of thought was very often wrong and suffered from "Phosphobia"! McKenzie had stated that high-phosphorus irons gave better properties, and certainly better wearing qualities, than low-phosphorus irons. From those articles, and his own experience, Mr. Shepherd had gathered that, as the result of taking phosphorus out of the iron, we had had in many instances to replace it by other materials. Metallurgists had started by using nickel, but were told that this resulted in an iron which was rather soft. Then they included chromium to harden it; and later it was suggested that "a pinch or two" of molybdenum would even things up; this was the general picture, as he saw it. It was realised that there were numerous cases where alloy additions were necessary, but it had been overdone. He urged that, if we had endeavoured to use high-phosphorus irons whenever possible, we should not have used alloy irons in such a way that they tended to become common practice rather than for special requirements.

MR. A. E. MCRAE SMITH agreed entirely with the references made to the superior wearing qualities of the high-phosphorus-containing irons. At the same time, there was the problem of their castability. It was well known that the liquid shrinkage characteristics of those higher-phosphorus irons was very poor. An excellent Paper by C. A. Timmins, of Climax Molybdenum, published about 12 months ago, showed that the difference between liquid and solid volume increased very rapidly as the phosphorus content increased. He could not see how some of the very complicated internal combustion engine cylinder block castings could be produced completely free from liquid shrinkage in high-phosphorus iron. He would like to ask Mr. Cook how he made such castings from high-phosphorus cast iron.

### Phosphorus in Cylinder Practice

MR. F. J. COOK replied that he had made thousands of complex cylinder castings, about as complicated as they possibly could be, in irons containing 1 per cent. phosphorus; bearing in mind particularly the maintenance of the proper carbon/silicon ratio, he had never experienced any porosity trouble whatever in those cylinders, which had to withstand steam pressure up to 300 lbs. per sq. in., at a temperature of more than 400 deg. F.

MR. MCRAE SMITH said that he was speaking of automobile cylinders, not steam engine cylinders.

MR. COOK commented that one could not produce satisfactory automobile cylinders in high-phosphorus irons with the carbon/silicon ratio specified in the formula. But he emphasised his earlier remark that, in cylinders of from ¾-in. to 1½-in. thickness, there was

no difficulty whatever in achieving high strength in high-phosphorus irons. Many years ago he had carried out more than 200 consecutive tests, covering two years' working, using a straight iron with no steel additions. The test figures for those castings were never as low as 14 tons per sq. in., the highest was 19.2 tons per sq. in., and the average for the 200 tests was 16.4 tons per sq. in. The wearing properties in all cases were very much better than in lower-phosphorus irons.

MR. SHEPHERD agreed that there were certain castings which must be made with somewhat lower phosphorus content than was referred to by Mr. Cook. Before the war the industry had become so scared about the use of phosphorus that every so-called modern metallurgist had tried to drive the phosphorus content to the lowest limit. His own view was that one should use as much phosphorus as possible, within reasonable limits, for it was in the national interest to do so, not only in wartime, but also in peacetime. The higher-phosphorus irons formed the basis of the old school of foundry technique, which did produce thousands of tons of really good castings; if these materials were used with intelligence and judgment we should be able to reduce very largely the cost of mixtures by reducing or in many cases eliminating alloys.

### Shock-Resisting Properties

DR. A. B. EVEREST pointed out that, in addition to the influence of phosphorus on soundness, there was another factor which assumed great importance during wartime, i.e., the mechanical or shock-resistance property. Phosphorus had a very deleterious effect on the properties of castings which were required to meet conditions such as those of under-water shock, and there was a tendency for the Services to step up their specifications; that was certainly not compatible with the use of the higher-phosphorus irons.

MR. COOK challenged the statement that high phosphorus content had a deleterious effect on shock resistance. Many years ago, he said, he had published figures relating to irons containing as much as 1 per cent. of phosphorus, which figures showed that, where the carbon/silicon ratio was right, those irons exhibited very much greater shock resistance under the drop load test than did the lower-phosphorus irons.

DR. EVEREST said that for the past two years he had been working on a Committee which was trying to develop a satisfactory impact test for cast iron, in order to satisfy the Service Departments. Much work had been done by that Committee on the influence of phosphorus on impact strength, and there was no doubt that, as shown by tests of the Izod type, as the phosphorus content increased the shock-resisting properties of the iron decreased very rapidly. As an example of the importance of shock resistance, he pointed out that motors were carried on brackets on board ship, and the brackets must have the ability to withstand the effects of shock such as might be caused by a depth charge or something of that sort.

Replying to a request that he should define "high phosphorus content," he said the Sub-Committee had set out in the Report the phosphorus limits which, in the view of the members, should not be exceeded if the various specifications were to be met. In his view it was necessary to limit the phosphorus content to less than 0.25 per cent. in order to meet the highest mechanical or shock-resisting properties specified. Medium shock resistance would be attained with a phosphorus content in the range of from 0.5 to 0.7 per cent. In the native irons, with a phosphorus content of about 1.2 per cent., the shock resistance was generally relatively poor.

MR. J. L. FRANCIS agreed largely with Dr. Everest that the higher-phosphorus irons were less resistant to shock than those containing lower phosphorus contents, but he added that the successful use of irons having the higher phosphorus contents was to some extent, and a not unimportant extent, bound up with the design of the castings to be made. In the case of sand castings having considerable sectional changes, ribs, brackets, water jackets and internal bosses, for example, it was very much more difficult to secure soundness and resistance to hydraulic pressure when the phosphorus content was much over 0.5 per cent. than when it was lower.

There was no doubt that the wear-resistance of castings was increased by the use of phosphorus. But, whilst it might be desirable under wartime conditions to use as much phosphorus as possible in the mixtures, foundrymen must ensure that that did not result in the production of wasters, which would entail extra work (at a time when labour was not easily available) and the use of extra fuel.

### Cast-Iron Guns

MR. BLAKISTON recalled that at a foundry he had visited recently there was included amongst the scrap a consignment of cast-iron guns which were about 120 years old. The iron of which they were made contained about 1 per cent. phosphorus. No matter how great the shocks to which the castings were subjected, which included a 1-ton drop from a height of 30 ft., it was found impossible to break them; eventually the gun barrels had had to be drilled all the way round before they could be broken down. Perhaps the Sub-Committee would be interested to find out why that iron possessed the superior characteristics which everyone tried to develop. In reply to a question, Mr. Blakiston said the carbon content was about 3.3 per cent., which was not abnormally low, and the silicon content was about 1.3 per cent.

DR. EVEREST commented that surely the important factor in the case referred to was that of the section. He added that the reference to the particular guns mentioned was perhaps a red herring, because, after all, the foundry concerned had not tried to break down guns made with other grades of iron.

MR. R. C. TUCKER was of the opinion that the guns referred to were made of cold-blast cast iron, so that they possessed superior toughness; and he suggested that if one tried to cast a gun-barrel with a high blast temperature modern pig-iron, one would not achieve the same results. With 1.3 per cent. silicon one obtained a very nice grey-iron structure in the old cold-blast

cast iron. The good results obtained were the result of the blast-furnace conditions under which the irons were made, and he urged that not sufficient fundamental research had been directed to that matter.

As the result of a pre-view of the Sub-Committee's Report, he had been able to overcome a foundry difficulty. In casting trench-mortar bombs by the method shown in Fig. 1 (a) of the Report, with the runner on the band, a certain number of scrappers (not "wasters") resulted through porosity on the band, as shown by air test. By adopting the method of manufacture shown in Fig. 1 (b), using top pouring, the troubles were overcome, even when using iron containing 1.2 per cent. phosphorus. Thus, a defect involving porosity at the ingate was overcome by a change of foundry practice. Whereas the low-phosphorus cast irons were comparatively foolproof in a jobbing foundry, the founding of the higher-phosphorus irons needed great care.

### Schofield Pyrometer

Dealing with Mr. Shepherd's question concerning the cost of the Schofield pyrometer, he said it was quite cheap, though he could not give specific figures; and its reliability had been proved in use, after the initial teething troubles had been overcome. The only maintenance item was the replacement of the sheaths, which cost about threepence each and lasted for about 20 determinations; the time occupied in replacing a sheath was about 3 min. One could buy a workshop potentiometer for about £18, or an indicating instrument. The platinum and platinum-rhodium thermocouple represented a first cost of not more than £4 or £5, which was not outrageous. It was difficult ordinarily to get a look at the iron before it was actually poured into the mould, because of the dirt, etc., on the top. The Schofield pyrometer, however, could be inserted straight through the slag. If the iron were reasonably hot, there was no difficulty in making an accurate estimate of the temperature. Again, if the iron were hot, the sheath was not damaged, but sometimes, when the iron was of the sticky type, it was necessary to replace the sheath after each determination.

Finally, Mr. Tucker recalled an instance in which, in the making of certain castings which had to be subjected to porosity tests, the percentage of wasters had been reduced from the former level of anything from 20 to 50 down to a regular 10 or 15 per cent. as the result of proper temperature control. The economy effected in that direction had covered the cost of the instrument hundreds of times.

The PRESIDENT (Mr. Dan Sharpe) agreed that, in the case of irons having a really high phosphorus content, beyond that mentioned so far in the discussion, the pouring temperature and the condition of the mould had a great deal to do with the porosity or the soundness, apart altogether from the chemical composition.

### Life of Denseners

MR. E. LONGDEN, who was invited to reply to Mr. Thornton's question concerning the life of denseners, said it depended on the type of casting, the temperature to which the denseners was subjected, and its location in relation to the runners, gates, and so on. The growth was not necessarily a hindrance to its repeated use; rather was its life conditioned by the maintenance or otherwise of its shape which would allow it to fit correctly on the location to be densened.

In heavy castings, where there was overheating of the metal of the densener, the aim was to gate the castings at points where there would be no direct impingement of the metal on to the densener, so that it would remain as cool as possible. The desirable section of densener to use again depended on the amount of metal which might be poured past the place at which the densener was situated. Any material which effectively protected the densener would help to minimise its growth. A refractory which would maintain its condition on the face of the densener was to be recommended. Denseners were not necessarily made of metal; various refractories, with an appropriate heat conductivity, could be used.

Incidentally, Mr. Longden said that the phosphorus content of the metal did not trouble him a great deal if below 1 per cent., for he was concerned with medium and heavy castings. A silicon content of from 1.0 to 1.2 per cent. and carbon content of about 3.1 per cent. would give sound metal. In certain classes of massive castings a manganese content of below 0.5 per cent. had given an excellent structure when combined with low silicon and moderate carbon content.

## CONVENER'S REPLY

MR. P. A. RUSSELL, replying to the discussion, dealt first with Mr. Shepherd's question concerning the addition of ferro-silicon. It was stated in the Report, he said, that "while early practice favoured the introduction of ferro-silicon in powdered form, granular form of pea size or even larger is now preferred." The Sub-Committee endorsed that, and might have stated even more strongly that the powdered form should be avoided. Whilst no mention was made in the Report of the improved machinability resulting from late silicon additions, he agreed with Mr. Shepherd that that was a very important factor.

Commenting on Mr. Cook's remarks concerning the maintenance of the proper carbon/silicon ratio, he drew attention to paragraph (7) in the section of the Report headed "The Future," in which the Sub-Committee advocated a reversion to the older method of getting good castings by concentration on silicon control, by running varied silicons to suit different thicknesses of castings, as distinct from using a low-phosphorus, and possibly low-carbon, iron which would suit a wide variety of sectional thicknesses. That, he agreed, did not meet Mr. Cook's point entirely; it might have done had the reference been to silicon *and carbon* control.

In reply to the requests for further information on

the carbon-silicon balance in relation to phosphorus content, the Sub-Committee felt that the best thing would be to refer those interested to the published work on this subject. Attention is, therefore, drawn to the following Papers:—

(1) F. J. Cook, "American versus British Grey Cast Iron." Proc. Inst. British Foundrymen, 1921-22, Vol. 15, pp. 287-304.

(2) R. Ruer and F. Goerens, "On the Mechanism of Melting and Solidification of Iron Carbon Alloy." Ferrum, 1916-17, Vol. 14, p. 161.

(3) G. Brinkmann and P. Tobias, "On the Relationship between Chemical Composition and the Mechanical Properties of Cast Iron." Die Giesserei, 1942, Vol. 29, September 18, pp. 317-320.

(4) Research Committee on High-Duty Cast Irons for General Engineering Purposes. Second Report—Phosphoric High-Duty Irons. Institution Mechanical Engineers, 1941.

As to Mr. Blakiston's objection to the method of manufacture of a cast-iron coupling in highly phosphoric iron, he said that, whilst it was appreciated that a great many castings were made in high-phosphorus iron, it was known also that certain people always made couplings in low-phosphorus iron. The case referred to in the Report provided such a startling example of how hematite and steel had been saved that it was considered to be well worth bringing forward. He believed the particular couplings under discussion were rather heavier than the average, and perhaps that explained why low-phosphorus irons had been used previously.

It was true that the Report did not emphasise the influence of phosphorus on the wearing qualities of cast iron. But the Sub-Committee did not attempt to write a general treatise on phosphorus; it was trying to help foundrymen who had to use irons of higher phosphorus content than were used formerly.

In reply to Mr. Rousham, he said the problem of labour shortage was somewhat outside the scope of the Sub-Committee; but he sympathised with the idea that if founders could obtain the raw materials they wanted they could ease their labour problem. However, it was not a question of balancing one factor against another, but rather a question of making the best of supplies, of which there was an absolute shortage or limitation; the hematite iron was just not there. Problems of shipping space, and so on, all entered into the general considerations.

All he would say on the discussion concerning high-phosphorus *versus* low-phosphorus irons, was that the use by the Americans of low-phosphorus irons had had possibly an adverse effect upon British practice. But wartime experiences were proving valuable, in that they were enabling us to get away from the low-phosphorus specification where it was unnecessary.

Great care must be exercised in considering American statements on high and low phosphorus since the phosphorus range of American irons is of a totally different order from those in this country. Thus, when an American foundryman spoke of high phosphorus he more often than not meant something less than 0.8 per cent. This point should not be overlooked, as it tends to lead to some confusion in considering American reports on this subject.

With further reference to the information already given by Mr. Tucker on the Schofield pyrometer, it is thought that those interested in this equipment and requiring further information might care to look up the Paper by F. H. Schofield and A. Grace entitled "A Quick Immersion Thermo-Couple for Measuring the Temperature of Liquid Steel both before and after being Tapped from the Furnace," and which is published on page 239 of the Iron and Steel Institute Special Report No. 5, this being the 8th report on the heterogeneity of steel ingots. The pyrometer as adopted for cast iron is substantially the same as that described in the Paper, but with less elaborate equipment required for manipulating the thermo-couple in the iron foundry.

## WRITTEN DISCUSSION

MR. J. L. FRANCIS wrote that in the course of the discussion it was suggested that a table giving the correct relationships between carbon and silicon for different percentages of phosphorus, so that casting trouble from the use of the latter could be avoided, would be valuable. Such information had already been drawn up in the work done on the effect of phosphorus on the shrinkage of cast iron, by the B.C.I.R.A. Since phosphorus increases the fluidity of cast iron and formed a low melting point constituent, it seems obvious that greater skill and precautions would be needed to produce sound castings as its ratio becomes larger, and the tendency for shrinkage trouble and porosity to occur would likewise keep in step with the increase in phosphorus content.

MR. W. T. BRUCE (Chesterfield) wrote in reference to coupling castings, that he was extremely interested in the method of making these in 0.63 P iron. The extremely small gate used, and the fact that the liquid pressure from the height of the riser and runner shown will be negligible, calls for particular comment. Further, the fact that an oil-sand strainer core is used for this particular purpose for these castings up to 15 cwts. excited his curiosity. It was a new factor personally with about 13 years' experience on high phosphoric irons alone, to know that castings of so heavy a section and proportionately greater area could be cast successfully with these tiny gates. For the small pulleys, he felt certain that ingates round about the dimensions given would more or less be successful in producing a good casting of this type, provided more liquid pressure was given by the use of more height on the runner and riser. Presumably, of course, the size of the gate and the height of the runners and risers are increased as the dimensions of the pulleys increase.

For his own part, if he were making these castings, he would have the ingate at least three times the dimensions of the gate shown at Fig. 5 for the casting of a coupling of 3 cwts., at the same time increasing the height of the riser and the head twice as much as that shown in Fig. 5, to give increased liquid pressure.

## Supplies for Grey Iron Foundries

The size of the ingates and the heights of runners and risers to be proportionately increased for every 1 cwt. increase in weight on the couplings made. The reasons given for these precautions being to counteract cold lap, cold shut, and the possibility of shrinkage due to the segregation of phosphorus at the point (see Fig. 4) in the metal of the section of the casting all round and above the inner fillet on the 12-in. dia. bush. The metal from the 2¾-in. section on the 21½-in. dimension would have to feed that lowest part, and liquid pressure is important in this extent.

Was it possible that more detailed information could be given in the near future on the casting of these couplings, in weights up to 15 cwts. each, particularly in regard to these matters referred to? It was almost incredible to learn that an oil-sand strainer core either made from sea sand or Leighton Buzzard fine, and bonded with a semi-solid, or one of the proprietary liquid core binders made from linseed oil, sulphate of lye, dextrine, and molasses, could stand up to 15 cwts. of hot metal being poured through it at slow speed. Personal experience of oil-sand cores made only with sea sand or Leighton Buzzard sand with no clay bond or moisture in them was, that in jobs where they were used, the quicker the job was poured the better, because of the danger of the core incinerating in casting.

An oil-sand core with, say, a good proportion of Dullatur sand in the mix with sea sand or Leighton Buzzard sand, plus an added percentage of moisture, would of course stand up to the duty required. Firms had used this mixture many years now in making high-pressure castings of semi-steel.

MR. E. L. HOWARD (Manchester) wrote that no doubt many methods had been used for the production of trench mortar bombs, all of which have met with some degree of success. He would like to describe briefly the method he had used which resulted in very few rejects due to porosity. The moulds were produced in green sand by plate moulding. Three castings were made per box and cast on the flat. The castings were run about 1 in. below the tip of the nose: a riser was not used, but a good head of metal was obtained by building up the runner box above the moulding box to the extent of 6 in. All moulds were made on machines and then placed on a conveyor. The composition of the iron was between the following limits:—T.C. 3.2 to 3.4; Si. 1.8 to 2.0; Mn. 0.6 to 0.7; S, 0.08, and Ph. 0.9 to 1.0 per cent.

There seemed to be little doubt that for some considerable time the supply of low-phosphorus iron would be limited and expensive, and many cases where it was deemed necessary to use these irons, equally good results can be obtained by proper attention to what was aptly termed foundry technique.

### Sub-Committee's Reply to Written Contributions

The Sub-Committee wish to thank Mr. Francis, Mr. Bruce and Mr. Howard for their further contributions to the discussion of the report. The point raised by Mr. Francis concerning silicon-carbon balance had now been dealt with in the verbal reply to the discussion at the Annual General Meeting.

With reference to comments by Mr. Bruce on the casting of couplings, the Sub-Committee were interested in the experience set out, but in view of the fact that there were clearly a large number of methods which could be successfully applied to the production of a casting of this type, they felt that there was nothing further they could add. The Sub-Committee were in full agreement with Mr. Bruce concerning the necessity for having a correct composition for the oil-sand strainer cores if they were to stand up to the passage of a considerable quantity of hot metal. The use of a core made from sea sand with core oil was clearly not to be recommended, and the type of mixture which the Sub-Committee would put forward as successful in practice was sea sand or equivalent silica sand plus 5 to 10 per cent. of silica flour mixed with any core sand binder and baked at 230 deg. C. The Sub-Committee wished to thank Mr. Howard for the details he gave of his method of producing trench mortar bombs.

## VISCOSITY OF LIQUID STEEL

In "Metallurgia italiana," L. LOSANA describes direct viscosity measurements on liquid steel in which damping curves were registered photographically. The viscosity of pure iron was measured between 1,550 and 1,700 deg. C. as a function of the temperature, and the effect of various alloying elements on changes in viscosity was studied. Carbon, even when present in small concentrations, was found considerably to reduce the viscosity, with silicon having a more pronounced effect. This effect could be followed only to a carbon content of 0.2 per cent., as higher concentrations seriously affected the refractory lining of the apparatus used. Manganese does not appear to affect the viscosity to any marked degree. Chromium raises the viscosity, very markedly so above a concentration of 2 per cent. A maximum viscosity is obtained around 10 per cent. Cr, but there is a reduction with a further increase in Cr content, a minimum being reached at around 20 to 25 per cent. Cr: there is again an increase of viscosity as the Cr is further increased. The minimum viscosity can be explained by the melting point of the alloy in question, but no explanation could be found for the maximum viscosity values. Nickel affects the value of the viscosity only at high concentrations; between 30 and 40 per cent. nickel the viscosity is reduced.

### Heat-Resisting Steel Castings

Recent developments in Germany in the production of emergency grades of heat-resisting steel castings are reviewed by R. SCHINN and R. v. TINTI in Report No. 615 of the materials sub-committee of the Verein deutscher Eisenhüttenleute, reproduced in "Stahl und Eisen" of February 18 and 25 last. The Paper is a useful summary of recent German work on steel and alloy steel castings, their production and heat-treatment, and physical and mechanical properties.

# POST-WAR PROSPECTS AND DEVELOPMENTS IN THE VITREOUS ENAMELLING INDUSTRY

*Paper read at the Annual General Meeting of the Institute of Vitreous Enamellers*

By J. T. GRAY (Stewart & Gray, Limited, London)

When I received the invitation from the Chairman to present a Paper at this meeting, his invitation embodied the title of the Paper, and this had such a wide scope that I was conscious of the fact that it could not adequately be dealt with in one Paper, especially as the time available to me was limited, so that I have been able to do little more than touch upon the various points that we will have to deal with in the immediate post-war years. I have purposely avoided the more technical aspects and endeavoured to give a broad word-picture from a commercial angle, but, of course, it is impossible not to touch upon the technical side, and I feel impelled to emphasise the importance of research to the industry in general.

When considering post-war prospects, we are to some extent compelled to reflect on the past, and these reflections tend to guide our thoughts in our endeavours to look into the future, but to assume that manufacturers will continue to favour vitreous enamel to the exclusion of other finishes is, in my opinion, to invite disaster.

We may wonder whether some countries which were in pre-war years non-industrial and which have now become industrialised as a result of the war, will in the post-war period manufacture for their own markets and thus reduce their imports, which, in turn, will affect our exports. Furthermore, we have evidence that much attention is being paid abroad to foreign markets by some exporting countries which are already engaged in the production of goods for such overseas trade, and we must not neglect any opportunity for meeting this competition.

In considering post-war developments, it may be advisable first to summarise the various problems which will require consideration in the order in which they will claim attention. In this respect, probably what may be termed the "reconstruction" of the enamelling shops will rank first.

A very large number, if not all, the enamelling shops throughout the country have been converted for armaments production and in most instances heat-treatment work has been undertaken, which has made it necessary to excavate shop floors; install quenching tanks; clear out spray booths and extraction systems, with the consequent dislocation of compressed-air lines and other equipment; and in a substantial number of plants, the conversion of muffle furnaces to open-hearth or semi-muffle furnaces has been necessary, while in a number of cases structural alterations to the buildings have had to be made. All this will have to be rectified before we can recommence enamelling on an efficient production basis.

We must ask ourselves, however, whether the shops are to revert to their pre-war lay-out and general arrangement, or will the post-war work involve considerable alterations to the equipment and its general lay-out? We must endeavour to find an answer to these questions before embarking on the complete or any extensive reconstruction of the enamelling shops. To this end we should pose a further question—what are likely to be the post-war goods to be enamelled? Will sheet iron pressings tend further to replace castings, and will the general tendency be towards making up larger sheet-iron components, requiring larger pickling and spraying accommodation, different methods of handling and drying, and variations in technique?

Until we have made a careful study and minute survey of the trend of these factors, we cannot adequately set to work to put our plants in efficient order, but having considered the class of work we shall be called upon to do, from such evidence as may become available, we can at least prepare our plans for the rearrangement of the enamelling shops which post-war circumstances are likely to dictate.

It may well be that the continuous furnace will be more widely considered by the larger manufacturers in Great Britain, and standardisation of apparatus would certainly have some influence in this direction. The use of these furnaces in this country has so far been very limited—I believe I am correct in saying that not more than three were installed before the war. It seems that, compared with those already installed, there may be a good case for a smaller-size continuous fusing furnace, but the economics of the smaller unit will demand careful consideration. This and similar developments, such as continuous or automatic spraying, will probably receive due attention in connection with processing and are the direct concern of all enamellers in their efforts to effect lower production costs and assist in making vitreous enamel more highly competitive.

### Potential Post-war Demand

We will naturally expect the general production of heating and cooking appliances to take a prominent and early place in post-war production programmes, but perhaps the hollow-ware section of the enamelling industry has before it an excellent opportunity to revive its trade and raise its output to a new peak, as most housewives will be demanding a new set of pots and pans as soon as these are procurable, and the hollow-ware manufacturers will still have their presses and are also in possession of their press tools so that they could probably resume production as soon as sheet metal becomes available for fabrication.

## Vitreous Enamelling Prospects

No doubt our friends in the hollow-ware trade are fully alive to the vast increase which has taken place in the development and production of new light alloys, possessing a high degree of ductility, much of which may prove suitable for the manufacture of cooking utensils. These alloys must inevitably become available for such purposes when the needs of war have been served, but enamelled hollow-ware in bright, harmonising colours will undoubtedly form an effective counter to such potential competition.

The gas and electric apparatus manufacturers will probably revert partially to their pre-war class of production, as new developments, important as they may be, will inevitably require time for their complete development and general acceptance. Therefore

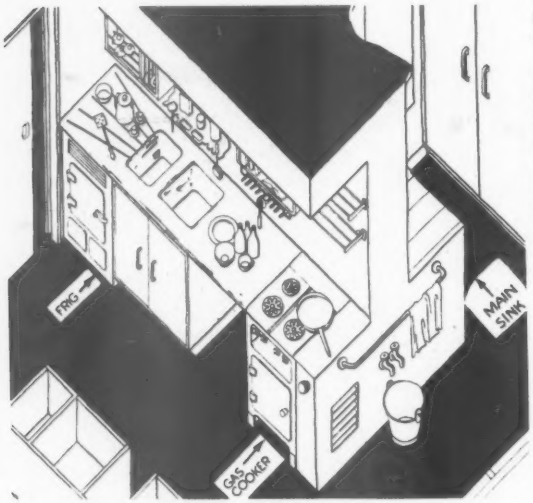


FIG. 1.—ENAMELLED KITCHEN EQUIPMENT.

they will not reduce to obsolescence all the pre-war production. It is apparent that enamellers generally will in some degree, at least in this branch of the industry, resume the enamelling of work similar to their pre-war output.

A regular perusal of the trade press and close examination of reports of many technical meetings, and committees, dealing with post-war reconstruction, reveals that a considerable amount of thought is being devoted to the post-war development of appliances, and it is interesting to note that vitreous enamel finishes are given a place in these considerations.* By a study of this and similar evidence in other industries, some indication can be obtained of the developments which may take place in the enamelling industry.

### "Unit Construction"

From a reference to the sources of information which I have outlined above, it is of particular interest to note the frequency with which the phrase "unit-construction" is employed in discussions on possible post-war developments, especially in connection with projected post-war housing construction. Bearing in mind the inescapable fact that when these and similar thoughts continue to be expressed and accepted in authoritative circles, something of the kind is bound to materialise, it is the obvious and manifest obligation of the leaders of the enamelling industry to ensure that vitreous enamel finishes are given a positive consideration in the initial stages of design.

The future of the enamelling industry is in the hands of its leaders, and on their energy, resource and knowledge of conditions *as they are*, will depend to a great extent whether the industry advances, stagnates, or recedes in competition with alternative finishes.

Relative to the application of vitreous enamel, interest will be centred chiefly in the kitchen equipment, where unit-construction is being considered along two lines. On the one hand, kitchen equipment, comprising, say, the cooker, refrigerator, water-heater, and washing-wringing machine, could be supplied separately from various manufacturers and fitted in line, uniform in height and other important external dimensions, with a vitreous-enamelled draining board, and possibly an enamelled sink on the lines shown in Fig. 1.

On the other hand, a method of equipping the kitchen, which is having some consideration, embodies a degree of standardisation, and I understand that this would comprise all the above-named equipment built to a standardised or rationalised specification, each piece of equipment being self-contained so that it would fit into a bench-like construction, the top and front of which would be vitreous enamelled. The enamelled top of this bench would probably also form the sink-surround and wall-skirting. The chief object of this type of construction is the reduction of initial and maintenance cost, and each piece of equipment can be separately removed and replaced with comparative ease.

If either or both of these schemes be adopted, it will be apparent that vitreous enamel finishes will form a prominent feature. It is not, however, intended that these projects should interfere with the market for regular, higher-grade apparatus, and these plans are being considered primarily in connection with the pre-fabricated house, and generally, the cheaper type of dwelling.

### Requirements of New Homes

There is, I am sure, little need for me to stress the almost illimitable field for enamelware which will

* Report of the Committee of Enquiry on Standardisation of Appliances. Part I—Domestic Gas Cookers. R. J. Rogers—Annual General Meeting, Institution of Gas Engineers, 1941. J. E. White—The Design and Supply of Domestic Gas Appliances. Institution of Gas Engineers, July 9, 1943.

become available with the end of the war, and if we fail to take full advantage of this opportunity for vitreous enamel, we shall have nobody to blame but ourselves.

For the first time in its comparatively short history, modern vitreous enamelling will be employed on a vast scale in connection, on the one hand, with the replacements necessitated by wartime damage, loss, or wear, while, on the other hand, there will be the concurrent need for furnishing the new homes which are already being planned throughout the country. As a matter of interest I would mention that statistics indicate that approximately four million families will be requiring new homes after the war; in addition, well over a million marriages have already taken place since September, 1939.

### Refrigerators

Prior to the outbreak of war, the refrigerator had begun to establish itself as a piece of household equipment in British homes, and the public demand for refrigerators, after their manufacture had ceased due to war conditions, provided ample proof of their increasing popularity. That the refrigerator is now being considered part of the standard household equipment is evident by its inclusion in a number of post-war housing schemes, and there is no doubt but that domestic refrigerators will be produced on a larger scale in post-war years.

In the past the external surface of the refrigerator has been finished in a synthetic paint, and it was only in very limited numbers that the exterior was enamelled, while the enamelling of the lining was almost universal. I feel, therefore, that a particularly good case can be made for a considerable increase in the numbers of refrigerators which could be finished completely in vitreous enamel, and thus appreciably widen the scope for the application of enamel in this field.

I believe that the refrigerator lining fabricated in one piece has reached its maximum economic dimensional limits—that is to say, approximately 4ft. × 4ft. × 2ft. Larger sizes will, I submit, continue to be best enamelled in appropriate sections.

It is perhaps of interest to observe that, while refrigerators have been produced in the United States in many millions, our American friends still refer to the all-enamelled refrigerator as a "de-luxe" model. I believe that, with correct planning and efficient processing, the finish of all refrigerators could come within this category at an economic cost, thereby further expanding the use of vitreous enamel in the sphere of household equipment.

### Pressed Steel v. Cast Iron for Baths

In another direction, there may very well be an attempt at the revival of the pressed steel bath, which was beginning to make its appearance a few years before the outbreak of war, but with a very limited success. It is doubtful, however, whether the pressed steel bath will have a successful future on the British market, in competition with the cast-iron bath, incorporating in its design modern developments in construction.

The opinion is expressed that the well-known cast-iron bath has too firm a hold on the public mind to be ousted by a pressed steel competitor, but should the steel bath, in course of time become standardized, to the complete elimination of the cast iron bath, this might very well result in the end of the old dusting process.

In considering post-war developments, it may be as well to bear in mind that associated with the bath there is, of course, the lavatory basin, and while in the past only a limited number of these have been made from steel stampings with a vitreous-enamelled finish, I am of the opinion that the lavatory basin represents a piece of equipment which commends itself to manufacture in sheet steel vitreous-enamelled, and if the designs could be standardised on a limited number of sizes, this might well result in a considerable extension in the use of vitreous enamel for the building trade.

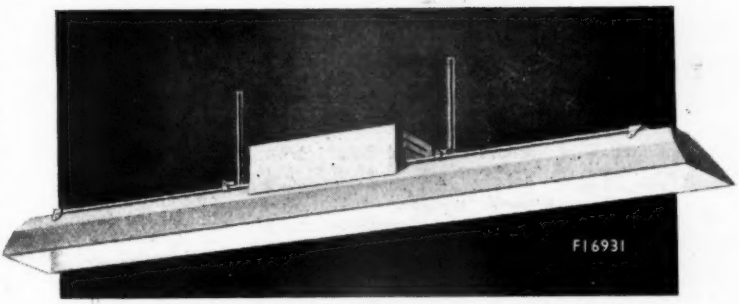


FIG. 2.—CHANNEL REFLECTOR FOR FLUORESCENT LIGHTING TUBES.

### Fluorescent-Tube Reflectors

Perhaps the only vitreous enamelware which has been in regular production throughout the war period is the reflector, and "black-out" conditions in workshops and offices having caused a large expansion in the use of the fluorescent tube type of lighting, many hundreds of thousands of channel reflectors for this form of lighting have been produced. Fig. 2 shows the type of reflector referred to. Owing to war-time conditions these reflectors have, in the main, been finished in synthetic paint, with the result that the design and fabrication have been determined with-

## Vitreous Enamelling Prospects

out any attention having been paid to the possibility of using a vitreous enamel finish.

The Company with which I am connected has been in consultation with some of the leading manufacturers of this type of lamp, with a view to modifying the design and fabrication of the reflector to make it suitable for vitreous enamelling, and we have been carrying out a number of enamelling trials to this end. In regard to this project I was pleased to learn that at least one firm in the Midlands has now received a substantial order for enamelling these trough reflectors.

It is the general opinion of the lighting trade and the user that the fluorescent tube form of lighting will supersede other forms of illumination, at least in workshops, and no doubt its use will be considerably extended. Particular attention is now being paid to the design of the reflector to make it a more substantial fixture and not the comparatively flimsy product which war-time conditions entailed.

The wide adoption of the trough- or channel-reflector could very well open up a new and extensive field for this class of work and probably link more closely the reflector section with the sign section of the industry, as the fluorescent tube and its possible developments may be the vehicle for extending the combination of vitreous-enamelled reflectors with advertising signs.

### Enamel Signs

The sign trade, an important section of the enamelling industry, may very well find in post-war years a considerable difficulty in reviving and increasing their volume of work in the advertising world, above that of the pre-war level, unless perhaps some new developments in technique are introduced to compete favourably with, for instance, neon signs, electric flashing signs, and the once-familiar animated electric sign which will almost certainly regain their popularity, and probably increase it.

For a large number of sites, the enamel sign manufacturer might suggest the reproduction of the article advertised, made up in steel pressings or sections suitably enamelled; for instance, a large-scale model of a bottle of patent medicine of familiar shape. The same would apply to brands of bottled beers, wines and spirits and a large variety of similar articles which could be reproduced many times their actual size and enamelled in appropriate colours so that the labels would form the advertising reading-matter.

In the case of more complicated articles, a plate could be cut to the outline of the article being advertised, the detail being incorporated in the enamelling of the plate. This could be made either single-sided or double-sided, according to the nature of the advertising site. This latter suggested method may be found more attractive for advertising such articles as motor-cars, typewriters, aircraft and similar products.

I put these ideas forward purely as a lead, but something of this sort will, I think, provide a welcome innovation, in contrast with what I might term the orthodox flat rectangular enamelled plate.

From another viewpoint the ever-increasing speed of the world in which we live and the rapid changes which will necessarily take place in the post-war world may cause a considerable reduction in the use of what we may term "permanent" advertising signs, with a corresponding increase in the "paper" advertising media, which can, of course, be changed almost daily, even though advertising the same product.

### Vitreous Enamel for Coach Fittings

The railways, in my opinion, offer a very wide scope for an expansion in the use of vitreous enamel. While a certain amount of enamel has been employed in the interior of some types of coaches, such as the major fitments of the main-line buffet cars, etc., only a small fraction of the potential use for enamel in railway rolling-stock construction has been exploited.

From personal discussions with designers and technicians on passenger coaches, I can confirm that their attitude is favourable to the consideration of vitreous enamel for both the exterior and the interior of their coaches, and although the use of enamelled steel plates for the interiors of the coaches may be limited, the exterior furnishes a much more profitable field for the application of vitreous enamel, provided that a number of fundamental requirements can be met.

The method of fixing external enamelled plates represents an important consideration as screw- or bolt-heads on the front of the plate would not be acceptable and would, of course, impair the streamline effect, but at the same time the plates must be so built in as to allow for ease of removal for replacement in the case of damage. Here is a problem which some ingenious member of the industry might like to set himself to solve. One of the railway people responsible for railway coaches, and with whom I discussed this matter some years ago, thought that the lower panels would become badly damaged from platform trucks and the like, but I find that anxiety on this score no longer exists.

Amongst other applications, there is the complete lining of the railway coach sanitary accommodation, the back-panels on the seats and the window-sills of the Underground coaches, all of which would probably lend themselves to vitreous enamel finishes. Here perhaps is an opportunity for the enterprising enameller to investigate further the possibilities in this truly enormous field.

*(To be continued.)*

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**Conveyor Belt Repairs.** Kautex (Plastics), Limited, Elstree Way, Elstree, Herts, have issued a leaflet which describes and illustrates an equipment and process for repairing conveyor belts. The method involves the use of a proprietory material called "Ultric," an automatic electrically-treated vulcaniser and screw-down press for assembling the vulcaniser on to the belt. The whole operation can often be done *in situ* without dismantling the belt.

# MALLEABLE IRON CASTINGS IN ORDNANCE

Applications of malleable iron in ordnance were very limited in peacetime, states Lt.-Col. J. H. Frye, Chief of the Materials Section, Service Branch, Technical Division, Ordnance Department, Washington, in "Steel." The necessity for its extensive use did not seem to exist. Differential carriers, cases, bearing caps, steering gear housings and other parts of Army trucks were made of malleable, but seldom were identified as such. When it became imperative to prepare rapidly for mechanised warfare on a tremendous scale, problems of material and production quickly assumed serious proportions. Metal conservation and the saving of every possible machine tool and man-hour became of paramount importance. Malleable iron was among the materials, the possibilities of which impressed many ordnance experts in the United States.

Malleable iron possesses the advantage inherent in a cast part in that it may be cored and cast into intricate shapes with a minimum use of metal. At the same time, lack of necessity of removing surplus metal saves machine tools and man-hours. A further contribution to this saving is the ease and speed with which malleable iron can be machined.

The physical properties of normal malleable iron are covered by Federal Specification QQ-I-666, which includes the following minimum values for two different types of malleable iron:—

| Ultimate strength tons per sq. in. | Yield point, tons per sq. in. | Elongation, per cent. |
|---|---|---|
| 23.6 | 15.6 | 18.00 |
| 22.3 | 14.5 | 10.00 |

In the production of machine-gun mounts and pintles, malleable iron has replaced steel to advantage. In the production of the Oerlikon 20-mm. gun mount, thousands of tons of strategic copper have been saved by the use of malleable iron in place of bronze castings. Of no little importance, too, is the saving in cost. With malleable use it was not even necessary to reduce machine speeds and feeds.

A similar case is that of the cleaning staff used in anti-aircraft guns, the fittings of which were originally machined from brass bar stock and now are of malleable iron. As a result, 10.46 lbs. of brass are saved on each staff. In place of this material, but 4.99 lbs. of malleable iron castings are required. Again machine tool time and man-hours are saved.

In the case of the Bofors 40-mm. anti-aircraft gun grip, a 16-lb. malleable iron casting replaces an assembly of forged parts which had necessitated a metal removal loss of 73 per cent. Substitution of malleable iron reduced the metal removal loss to 32 per cent., saving machine tools, man-hours, metal cost and time. In a similar manner a mortar gear case, originally machined from a solid forging was made of malleable iron and passed all tests. Coring the part produced savings similar to those in the other cases.

In motorised equipment malleable iron has been used to advantage in many cases, as in jeeps, scout cars, half tracks and motor-cycles. New steering problems, involved in front-wheel drives, occasioned the use of additional steering knuckle parts of malleable iron. Motor-cycle hubs and frame members are also cast in malleable iron to advantage. A recent application in which malleable has been used to advantage is in the newly developed motor vehicle anti-aircraft gun mount.

### Pearlitic Malleables

Some mention is also due to the effective part played by pearlitic malleables in a number of applications. Ordnance early recognised the possibilities of this type of malleable iron, which has increased strength and wear resistance, although, of course, at some reduction of ductility and machinability as compared with normal malleable. As adequate specifications were lacking in both Government and industry, it was necessary for ordnance to pioneer and develop specifications. Three grades of pearlitic malleable were developed, ranging in yield point from 19.2 to 26.8 tons, and with elongations from 10 to 5 per cent., with corresponding hardness ranges.

An application in which pearlitic malleable has effected great saving and been of inestimable value, due to its many times greater life, is in the tank track roller. Formerly these rollers were made from steel and consisted of a cast hub weighing 34½ lbs. in the rough, which was machined to take a steel tube with ½-in. wall and weighing 17½ lbs. Two pounds of welding rod were required to weld the tube to the hub. The roller was then machined and weighed 48 lbs. finished.

This assembly has now been replaced by a pearlitic malleable casting weighing 60 lbs. in the rough and 57 lbs. finished. The outer diameter is cast within a $\frac{1}{16}$-in. limit and does not require machining. To assemble, weld and machine the steel roller required 2¼ hrs.' time as compared with an hour of machine time for the pearlitic malleable. The average life of the malleable roller is 10 times that of the assembly first used.

Use of the pearlitic malleable roller, therefore, saved 1¼ hrs. of machine time and 6 lbs. of metal per roller; or 10½ hrs. of machine time and 36 lbs. of metal per tank. Due to long life obtained, the ultimate saving per tank is 105 hrs. of machine time and 2,880 lbs. of metal.

Another and possibly even better known application of pearlitic malleable is the cover plate of the tank track. In this use thousands of tons of pearlitic malleable have gone into effective service. Also pearlitic malleables have saved metal and machine time in numerous small arms applications.

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**Synthetic Distilled Water.**—The Editor of "The Iron Age," in answer to a correspondent, stated that synthetic distilled water has been produced by the Permutit Company, 330, W. 42nd Street, New York City, and Resinous Products & Chemical Company, of 22, West Washington Street, Philadelphia. A saving of 99 per cent. in cost is claimed.

# SOME FOUNDRY PROBLEMS OF THE FUTURE

## MR. LOCKWOOD'S PRESIDENTIAL ADDRESS TO THE LONDON BRANCH

Mr. H. W. Lockwood, having recovered from the illness which postponed his installation as President of the London Branch of the I.B.F. two months ago, was formally inducted at the Branch meeting on September 23, at the National Liberal Club, London, S.W.1, and was warmly welcomed by his many friends and colleagues. MR. TEMPLETON claimed the honour of inviting Mr. Lockwood to occupy the Presidential chair. He expressed the general feeling of pleasure that Mr. Lockwood had recovered from his illness, but did not waste words in eulogy of a man whose qualities and services to the Branch were so well known and appreciated. He wished Mr. Lockwood happiness and success in his office.

MR. LOCKWOOD, having occupied the chair, amid applause, expressed his appreciation of the confidence reposed in him by his colleagues in the Branch, and delivered his Presidential Address, in the course of which he pointed out that at the last meeting there was presented an exchange Paper received from the Branch's "opposite number" in the United States, the Metropolitan Chapter of the American Foundrymen's Association. He hoped they would be able to extend exchange arrangements after the war, so as to receive Papers from Branches similar to the London Branch from other countries. More prominence was also being given to matters connected with non-ferrous foundries, and the Branch's programme now included meetings at Slough—an innovation which they believed would be appreciated by those who found difficulty in travelling to meetings held in London. Such meetings had certainly brought new members to the Branch.

Much Institute activity was being devoted to education, and the degree course at Sheffield University, and training at the British Foundry School in Birmingham, were intended to educate young men for responsible positions in foundries. So far, so good, but to-day and especially to-morrow it would be necessary to go further than scientific and practical education if we were to keep pace with modern tendencies. It was not much use educating young men for the foundry industry when we knew they would be expected to work under conditions much inferior to those obtaining in other crafts. Conditions of labour, air conditioning, lighting, health, hygiene, nutrition, all required scientific study. Work in the foundry of the future could become a pleasant occupation instead of an onerous task, as in most cases it was at present. When some of the jobs being done in some of our foundries were called to mind it was possible to realise how much study and thought would have to be applied to effect such a drastic changeover.

### Problems to be Faced

Heating, or rather the control of temperature, and purification of the atmosphere would require much attention, and many problems not easy of solution would be posed in this connection. Lighting had received some attention in the past, and wartime blackout conditions had compelled a fairly close study of the subject of artificial lighting. The post-war aspect of this subject would, of course, be the problem of making the best use of daylight.

Above all, however, was the subject of health, continued Mr. Lockwood, and since we lived by what we ate and drank, the question of food was closely bound up with health. It was a fact that the health of this nation in wartime was better than it was in peacetime, despite the limitation of variety of foods. A major reason for this was the wartime expansion of works' canteens, and he thought the reason was easy to see. Hundreds of thousands of people were now getting at least one good well-balanced meal per day provided for them in canteens. Some firms sent hot drinks round the works immediately on arrival of a shift in bad weather, and found that the short time spent in serving and consuming the beverage was a help to production and had a beneficial result on health and morale.

Nutrition opened up a vast field for study, involving as it did nothing less than perfect health for everybody through the provision of adequate nourishing food, and first-class working conditions. It had been said that workers preferred to eat their mid-day meal in what an industrialist has described as "comfortable cubby-holes." We all knew those comfortable cubby-holes, and what awful places some of them were. Human nature being what it is, there was certain to be opposition to any form of change, and it had been the experience of many managements that canteens built during the war at the instigation of the Government attracted only a minority of the workers. As time went on, however, more and more people gave the canteen a trial, until eventually the majority were enjoying the facilities provided. It could not be considered harsh to make it a condition of employment that all meals, including those brought from home, must be consumed in the canteen.

### The Manager of the Future

Management was undergoing a change, considered Mr. Lockwood. The old idea of a works manager being chosen for his knowledge of manufacture and his ability to get the maximum work for the minimum pay was disappointing. The manager of the future would be of a different type—what one might almost describe as a professional manager. His primary duty would be to see that the human element working under him was in the finest possible physical and mental condition. It was easy to get the best machinery by merely paying cash for it, but it needed first-class management to ensure that the brains and muscles of the operatives were in first-class condition. He would already know that good working conditions were essential, and that the offer to workpeople of money in the form of bonuses, etc., was not by any means the only method of increasing production or of building up enthusiasm in the worker. This foundry manager of the future would be much more than a man who knew how to make castings. He would have

to know much about the attainment and maintenance of health, food and nutrition, hygiene, heating and air conditioning, fume extraction, lighting, with more than a smattering of psychology.

Proceeding, Mr. Lockwood suggested that they in the London Branch should adjust their programmes to meet the new conditions. Let them provide their young man with lectures on the subjects which he would have to study. They had devoted much time and effort to the consideration of mechanical devices for the foundry, some of which had been described as "almost human." They had heard of firms owned by horse lovers, whose healthy, well-fed draught-horses pulled record loads of pig-iron or scrap, or coke. They had yet to hear of a foundry which prided itself on the physical fitness and mental alertness of its operatives. And yet how much more important were these attributes than anything else on the plant. The study of men and their well-being in industry would be a big feature of post-war management, and he would like to see the Institute abreast with the times. Let them keep in continuous view this new conception of management, which he thought would play such a vital part in post-war industry. If a motto for the future were required, he thought it could be "Science and Labour hand in hand with Good Management."

### Vote of Thanks

MR. G. C. PIERCE (Past Branch-President) moved a hearty vote of thanks to the Branch-President for his excellent address. Commenting that in the past he had been a little critical of statements made and views expressed in presidential addresses, he said that on this occasion he agreed with the address wholly. In view of the fact that the country was at war, there were many matters which could not be discussed; but Mr. Lockwood had touched upon most of the matters which it was worth while to mention and which it was permissible to discuss.

DR. A. B. EVEREST (Past Branch-President), who seconded, recalled the debt which the Branch owed to Mr. Lockwood for his services in the past; and added that if he kept before him the visions he had described in his address, the Branch could look forward to continued success during his year of office.

The vote of thanks was accorded with acclamation, and the Branch-President briefly responded.

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**Howard Magnesium Foundry.**—The magnesium department of the Howard Foundry Company in the United States has been expanded during the past year to become one of the largest magnesium jobbing foundries. Capacity has been increased to about 500,000 lbs. per month from scratch just over a year ago. Among the castings made is one weighing about 50 lbs., although 60 in. in dia. and 18 in. deep and requiring approximately 5 tons of sand for the mould. Other unusual castings, such as blower cases on one of the largest radial aircraft engines have also been produced. About 2½ million lbs. of magnesium must be handled to secure a monthly quota of 500,000 lbs.

## CANADIAN BASE METALS

Canada is now topping all previous records in the production of base metals, states "The Iron Age." While figures for 1942 are impressive, those for 1943 will be better, due to further expansion in nickel production and larger output of nickel and copper, some of which is from new producers. The remarkable advance in base-metal output has not been secured without sacrifice on the part of established producers. Certain major deposits have been mined at a rate which is abnormal and reserves have been seriously depleted.

Canada's aggregate refined production of copper, nickel and zinc for 1943 is estimated at 827,800 tons, as against 662,100 tons for 1939, states the July issue of "Canada at War." Canada is now producing 95 per cent. of the combined nickel output of the United Nations; 20 per cent. of the zinc output; 12½ per cent. of the copper output; 15 per cent. of the lead output; 75 per cent. of the asbestos output; and 20 per cent. of the mercury output.

For the first time since 1939, the Canadian Government has made known production figures on base metals, which are as follow:—

| | 1942. Tons. | 1939. Tons. |
|---|---|---|
| Refined copper ... ... | 270,600 | 232,000 |
| Refined lead ... ... | 243,800 | 191,000 |
| Refined nickel ... ... | 93,300 | 64,500 |
| Refined zinc ... ... | 216,000 | 175,600 |

Canada is the greatest base metal exporting country in the world, and this year its output will attain the highest peak in history. This has been achieved by an enormous expansion of the aluminium industry, development of a Canadian process for the production of magnesium, extension of recovery methods at large base-metal mines, revival of old mines and exploitation of new marginal and sub-marginal deposits.

The aluminium industry provides possibly Canada's most spectacular story of wartime expansion. The Canadian output is more than six times that of 1939, is more than the total output of the rest of the world in 1939, and is supplying about 40 per cent. of the war requirements of the Allied Nations; yet the demand is now so great that 18,000 lbs. is required for one large bomber, and civilian curtailment will continue until the war is over. Efforts have been made to stimulate production of tin, tungsten, molybdenum, mercury, chrome and manganese; and, where necessary, to build up stock piles of imported metals.

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**Nickel Bulletin**—The August/September issue of "The Nickel Bulletin" contains abstracts of recent work on brazing and welding methods for tool-tipping high-speed steel, low temperature properties of arc-welds in Monel, identification of sulphides in nickel alloys, the resistance of low alloy steels to corrosion, and a number of articles on cast iron. Copies of the "Bulletin" may be obtained free of charge from The Mond Nickel Company, Limited, Grosvenor House, Park Lane, London, W.1.

## NEWS IN BRIEF

TWO SUBMARINE ENGINES have been built in the Midlands, and will shortly be in service. A constant supply of such engines will soon be flowing regularly from the builders' works.

MR. T. BERNARD STEADMAN, who has been in the service of W. H. Dorman & Company, Limited, engineers, of Stafford, for 50 years, has been presented with a cheque by the firm in appreciation of his long service. Mr. Steadman occupies the position of progress superintendent.

THE NATIONAL MALLEABLE & STEEL CASTINGS COMPANY, incorporated in Cleveland, U.S.A., in 1868 as the Cleveland Malleable Iron Company, is this year celebrating its 75th anniversary. Headquarters and research laboratories are maintained in Cleveland, with plants in Cleveland, Chicago, Indianapolis and Sharon, Pa.

THE HEATON FOUNDRY COMPANY, LIMITED, of Newcastle-upon-Tyne, have designed and placed upon the market the "Polford" core-sand mixer. It is stated to take up a minimum of space, require but little maintenance because the bearings run in an oil bath, and it is rapid in action. An adjunct to this machine is the "Polford" measuring hopper. Patent rights for both items have been applied for.

ARRANGEMENTS have been made for a joint meeting of the Newport and District Metallurgical Society and the Iron and Steel Institute to be held on Saturday, October 30, 1943, at 6 p.m., at the Newport Technical College. Mr. G. H. Latham, J.P., will preside. Principal C. A. Edwards, F.R.S., will present the paper by himself, Mr. D. L. Phillips and Mr. Y. H. Liu on "The Yield Point in Steel."

THE NATIONAL FEDERATION OF SMALL MANUFACTURING ENGINEERS, LIMITED, has been registered as a company limited by guarantee without share capital. The Council comprises the following:—E. H. Potter, Rectory Works, North Cray, Kent, J. C. H. Martin, W. J. Peckett (W. J. Peckett Engineering Company, Limited), J. A. Gray, H. Allen, W. A. Leitch (Metalmacs, Limited), R. G. Durbidge, L. J. Thompson and T. W. Barfoot.

THE COURT set up by the Minister of Labour to inquire into the dispute with respect to the terms of employment of many thousands of women engaged in engineering work at an undertaking in Scotland has recommended that negotiations between the parties should be resumed upon a system of grading and upon the classification of the various operations within the grading system.

AT BIRMINGHAM QUARTER SESSIONS fines of £15 on each of 58 employees of an engineering works in Birmingham for taking part in an unauthorised strike were reduced on appeal to £5. The Recorder, Mr. H. J. Wallington, K.C., said it was a grave step to strike in that way, but the stipendiary magistrate might not have had in mind the fact that with the incidence of taxation the penalty would be nearly equivalent to four weeks' wages.

## CHANGES IN RATES OF WAGES

In the industries covered by the Ministry of Labour's statistics, the changes in rates of wages reported to have come into operation in Great Britain and Northern Ireland during August resulted in an aggregate increase estimated at nearly £30,000 in the weekly full-time wages of over 360,000 workpeople, and in a small decrease in those of nearly 4,000 workpeople. The industries in which wages were increased during August included iron and steel manufacture, iron-ore mining, and tinplate manufacture. The flat-rate additions to wages in the iron and steel industry (pig-iron manufacture, iron puddling, steel melting and rolling, etc.) were increased in most districts by 1.6d. a shift for men and 1.2d. or 0.8d. a shift for youths and boys, as a result of the operation of sliding-scale agreements. Increases of similar amounts took effect in iron-ore mining in some districts and in tinplate manufacture. Decreases of small amounts were reported in iron-ore mining in Cumberland and the Furness district of Lancashire. Of the total increase of £30,000, about £22,000 was due to arrangements made by joint standing bodies; £5,000 was due to the operation of other cost-of-living sliding scales; and nearly all the remainder was the result of direct negotiations between employers and workpeople or their representatives.

## WAGES INCREASES FOR CANTEEN WORKERS

Increases in the basic minimum wage rates for canteen workers employed by member firms of the National Society of Caterers to Industry and covered by a National Joint Industrial Council agreement are announced. Beginning with payments made in the week commencing October 11, the minimum wages for adult workers are increased by 2s. 6d. a week. Proportionate increases are made in the wages of workers under 21. Parties to the Joint Industrial Council agreement, in addition to the Society, are the National Union of General and Municipal Workers, the National Union of Distributive and Allied Workers, and the National Union of Railwaymen.

The new minimum weekly rates for adult workers, who also receive meals and other emoluments valued at 10s. a week, are: Men chargehand cooks, 80s.; men assistant cooks, 70s.; women chargehand cooks, 55s.; women assistant cooks, 50s.; kitchen porters, London area, 65s., outside London area, 62s. 6d.; women cashiers and clerical workers, London area, 48s., outside London area, 45s. 6d.; women cleaners and general workers, London area, 43s., outside London area, 41s. 6d. The agreement provides for annual holidays with pay, sickness pay and additional rates for overtime and night work.

MR. HAROLD BOOT, commercial manager of the Consett Iron Company, Ltd., has been appointed assistant general manager.

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## NEW COMPANIES

*("Limited" is understood. Figures indicate capital. Names are of directors unless otherwise stated. Information compiled by Jordan & Sons, 116, Chancery Lane, London, W.C.2.)*

**Angle Bank Welding Company,** Angle Bank, Great Lever, Bolton—£1,000. J. W. and J. Priestland.

**Crowborough Engineering Works** — £2,000. B. Blewitt, 141, Fenchurch Street, London, E.C., subscriber.

**Fine Art Arc Welding Company,** 147, Wanstead Park Road, Ilford, Essex—£2,000. H. J. C. Wiseman and H. H. Rose.

**Hollyfield Engineering Company,** 3, Fife Chambers, Fife Road, Kingston-on-Thames, Surrey — £3,000. G. R. Jones and E. A. Shelley.

**Melville Thomas,** Hurst Mill, Pershore Road South, Kings Norton, Birmingham—Welding engineers and consultants, flux manufacturers, etc. £1,000.

**Jones & Mason (Castings),** 121, High Road, Short Heath, Willenhall—To take over a business carried on at Castwell Foundry, Short Heath, by Thomas Mason. £3,000. C. E. Mason and S. R. Hill.

**Dartford Shipbuilding & Engineering Company,** 38, Victoria Street, London, S.W.1—£10,000. A. E. W. Baines, A. L. Bersey, H. Caddick, J. H. Laithwaite, T. P. Laithwaite, J. T. Stratford and J. Stratford.

**Whitford Armstrong & Company,** 4, Wharf Road, Stratford, London, E.15—To take over the business of an engineer carried on at Royal Ironworks, Burford Wharf, London, E.15. £5,000. J. S. and H. G. Armstrong.

## COMPANY RESULTS

*(Figures for previous year in brackets)*

**Colvilles**—Interim dividend on the ordinary stock of 3% (same).

**T. M. Birkett & Sons**—Final dividend of 10%, making 15% (same).

**Metal Agencies Company**—Interim dividend of 3¾% on the ordinary shares (same).

**Thos. W. Ward**—Final dividend of 6¼% (7½%) on the ordinary shares, making 10% (11¼%) for the year.

**Dickson & Mann**—Profit for the year ended March 31 last of £1,502, reducing the debit balance carried forward to £906.

**William Bayliss**—Profit to July 31 last, £7,349 (£10,716); depreciation, £636 (£668); tax, £3,400 (£6,650); to general reserve, £1,000 (same); dividend of 7½% (same), £2,250; forward, £3,275 (£3,212).

**Sheffield Forge & Rolling Mills**—Net profit for the year to June 30 last, before providing for taxation, £31,735 (£32,489); taxation, £17,803; to general reserve, £5,000; dividend of 1s. 3d. per 6s. 8d. share, or 18¾% (1s., or 15%); forward, £6,511 (£5,244).

**Ransome & Marles Bearing**—Net profit for the year to June 30, after taxation and depreciation, amounts to £122,699 (£119,434); premiums payable under War Damage Act, £12,643; final dividend of 11%, making 20% (same); to reserve for contingencies, £35,000; forward, £78,928 (£76,872).

## OBITUARY

MR. HARRY TEMPEST VANE, who died suddenly at Farnham Common on October 9, aged 68, was managing director of D. Napier & Son, Limited, aero-engine manufacturers, from 1913-1932.

MR. W. S. PARR, general manager of Harper Phillips & Company, Limited, ironfounders, Grimsby, died on October 6, aged 60. Mr. Parr had been associated with the firm for thirty years.

MR. JOHN STORRIE, assistant manager for Queensland of Stewarts and Lloyds (Australia) Pty., Limited, died on August 12. A native of Motherwell, Mr. Storrie began his career at the Dalziel Steelworks. He was 51 years of age.

MR. HUGH MYDDLETON BUTLER, J.P., who died at St. Ann's, Burley, Leeds, on October 10, at the age of 86, had been in partnership with his brothers in the Kirkstall Forge, Limited, Leeds, since 1875. He was a member of the Institution of Mechanical Engineers. He sat as Conservative M.P. for North Leeds, 1922-23.

WE REGRET TO RECORD the death of Dr. W. H. Hatfield, D.Met., F.R.S., the director of the Firth-Brown research laboratories, who died at his home in Sheffield last Sunday, a few hours before he was to have taken part in a broadcast featuring the Sheffield steel industry. Dr. Hatfield was born in Sheffield in 1882, and received his technical education mainly as an evening student in the metallurgical department of the University College, Sheffield, under Professor Arnold. Quite early in his career he was appointed to supervise the manufacture of malleable cast iron at the now defunct firm of Crawley's. This early interest in foundry practice was sustained throughout his career. In 1909 he joined the Institute of British Foundrymen, and later presided over the Sheffield Branch. His book, "Cast Iron in the Light of Recent Research," was a standard text book for many years. Since the last war Dr. Hatfield devoted much attention to the development of 18:10:2 stainless steel (Staybrite), and some authorities credit him with its invention. He was particularly prominent in technical institute activities, especially the Iron and Steel Institute, of which body he was a vice-president. He was honoured with a Fellowship in the Royal Society, and there can be few engineering and metallurgical institutes which have not had the pleasure of listening to his Papers. As a lecturer he was dogmatic, skilful in debate, and sincere. His energy was prodigious, and by his own efforts or as a prime mover in the production of Committee Reports he has created a vast literature on a wide variety of metallurgical subjects. His outstanding personality will be sincerely missed, not only in the great professional Institutes, but in the dozens of ministerial, technical and educational committees upon which he served.

A JOINT MEETING of the Institution of Mechanical Engineers and the Institution of Electrical Engineers will be held at Savoy Hill, London, W.C.2, on Thursday, November 4, at 5.30 p.m. Mr. J. R. Rylands and Mr. J. R. Jenkinson will discuss "Bonded Deposits on Economiser Heating Surfaces."

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HOLDENS

## Raw Material Markets

### IRON AND STEEL

The demand for pig-iron is somewhat unequal. The light-castings trade is one of the few industries which is not fully employed, and the call for No. 3 iron is distinctly sluggish. On the other hand, in spite of some recent slackening in certain departments, engineering establishments as a whole still have an abundance of work in hand, and the demand for low- and medium-phosphorus iron and hematite is not readily satisfied. Mixtures of satisfactory quality are being provided by the extended use of refined iron, and a somewhat better output of iron with a low-phosphorus content, but the scarcity of hematite is still pronounced and its use is severely restricted.

The difficulty of obtaining steel bars has been the means of educating many users to the suitability of crown iron bars, for which there is now a fairly brisk demand. Deliveries of home produced billets, blooms and sheet bars have been raised to such a satisfactory level that the re-rolling industry is able to maintain fullscale activity without recourse to the use of imported material.

Among a wide range of rolled steel products, only heavy joists can be supplied at comparatively short notice. Makers of light structural steel in the form of angles, channels, rounds, and flats have work in hand to keep them busy until Christmas, and still later delivery dates are indicated for plates and the thicker gauges of sheets. All classes of bars are a very active trade, and fresh inquiries for these from a wide range of users have been reported. In small bright-drawn bars, also, producers continue to report a brisk trade. Aircraft works and other users of special alloy steels are taking steady deliveries, and there is no lack of replacement business in the market. A satisfactory feature is that deliveries, although extending to from three to four months against new orders, are being obtained more quickly than in certain other sections of the steel trade.

Substantial tonnages of iron and steel scrap are reaching the steelworks and foundries and, generally speaking, consumers have no complaints as to the availability of supplies. On the contrary, some descriptions of ferrous scrap are in greater supply than the present demand can immediately absorb. Steelworks are ready buyers of heavy steel scrap cut to furnace sizes, and there are always openings for short steel scrap suitable for foundry purposes and refined pig-iron making. The more extended use of chipping and other machines has resulted in a better absorption of light scrap, such as engineering turnings, but these are still not always easy to dispose of. Bundled and compressed scrap generally finds a ready market. Ironfoundries are securing all the cast-iron scrap they need, and in some districts certain grades are moving away less freely than merchants would like them to do. Heavy cast iron, however, is not as free as it might be.

### NON-FERROUS METALS

The supply situation in the non-ferrous metals may be considered very satisfactory. In copper, particularly, the situation has greatly improved in recent months. It is true that U-boat activity has become greater again, but it is not such as to imperil supplies. An important factor leading to the improvement in the copper supply position has been the more extended use of scrap, both in this country and on the other side of the Atlantic. At the same time, there has undoubtedly been some lessening of the rate of output of copper and brass munitions. Large quantities of copper will continue to be needed by the United Nations so long as hostilities continue, but it seems likely that demand has passed its peak. Should there, however, be a further expansion of demand the authorities have the situation well in hand, and there can be no doubt that all requirements will be met. The easier situation applies equally to all non-ferrous metals with the exception of tin. In this latter case, substitutes have to be used wherever possible, and many uses have been cut out altogether. While the mines in the Far East remain in Japanese hands, there can hardly be any improvement in tin supplies. The spelter situation is presumably satisfactory, but the authorities are not allowing this fact to influence policy, and supplies are only allocated where a definite need for metal in the interests of the war effort can be shown to exist. The same considerations apply to the distribution of lead, which is probably in better supply than any other of the non-ferrous metals.

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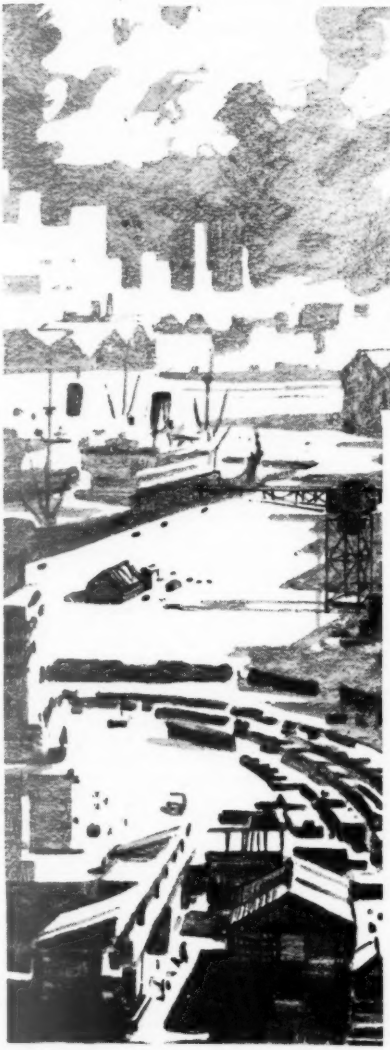
MR. J. M. POLSON has been installed as president of the North-Eastern (Tyneside) branch of the Institute of Welding.

IN THE UNITED STATES, almost 165,000 steel industry employees have left their jobs to enter the armed services through enlistment or induction, states the American Iron and Steel Institute. Included in that total are management and operating executives, metallurgists and engineers, as well as highly skilled and experienced mill workers. Replacement of such a large number of valuable employees has presented serious problems. The total number of steel workers now in the services represents one out of every four employees at work in the industry in the autumn of 1940.

DATA BOOK OF METALS AND ALLOYS.—A data book of 340 tables covering metals and alloys, written by S. L. Hoyt, of Battelle Memorial Institute, has been published by the Reinhold Publishing Corporation, New York. The 324-page cross-section of the more important data on metals and alloys covers in many different units non-ferrous alloys, stainless steel, cast iron, wrought steel and others. Data for the heat-treating steels are included. A chart on hardness tests, a large table of conversion factors, standard grain sizes, an index of 1,500 items, and specific data on resistance to corrosion are included. The price is $4.75.



## PRODUCTION FORGES AHEAD —GLENBOIG'S VITAL PART

THE refractories industry is, to-day, meeting unprecedented demands for firebricks capable of withstanding increasingly severe service conditions. Despite all difficulties, more Glenboig firebricks than ever before are being manufactured. A strict manufacturing control is in operation at all the Glenboig works and by the continuous application of chemical and engineering research every precaution is taken to maintain the highest standard of uniform quality. This explains why users are obtaining a vastly increased volume of Glenboig products capable of withstanding the most severe furnace conditions. Technical advice and assistance is available to users on all furnace-lining problems.

42/44% $Al_2O_3$
**GLENBOIG SPECIAL**
**GLENBOIG SPECIAL CROWN**

36/38% $Al_2O_3$
**GLENBOIG · GLENBOIG CROWN**
**CASTLECARY**

34/35% $Al_2O_3$
**DYKEHEAD · GEM**

THE GLENBOIG UNION FIRE CLAY CO. LTD., 48 WEST REGENT ST., GLASGOW, C.2.

GENERAL REFRACTORIES LTD., GENEFAX HOUSE, SHEFFIELD, 10.

# GLENBOIG

# CURRENT PRICES OF IRON, STEEL AND NON-FERROUS METALS

(*Delivered, unless otherwise stated*)

Wednesday, October 20, 1943

## PIG-IRON

**Foundry Iron.**—CLEVELAND No. 3: Middlesbrough, 128s.; Birmingham, 130s.; Falkirk, 128s.; Glasgow, 131s.; Manchester, 133s. DERBYSHIRE No. 3: Birmingham, 130s.; Manchester, 133s.; Sheffield, 127s. 6d. NORTHANTS No. 3: Birmingham, 127s. 6d.; Manchester, 131s. 6d. STAFFS No. 3: Birmingham, 130s.; Manchester, 133s. LINCOLNSHIRE No. 3: Sheffield, 127s. 6d.; Birmingham, 130s.

(*No. 1 foundry 3s. above No. 3. No. 4 forge 1s. below No. 3 for foundries, 3s. below for ironworks.*)

**Hematite.**—No. 1 (S & P 0.03 to 0.05 per cent.): Scotland, N.-E. Coast and West Coast of England, 138s. 6d.; Sheffield, 144s.; Birmingham, 150s.; Wales (Welsh iron), 134s. East Coast No. 3 at Birmingham, 149s.

**Low-phosphorus Iron.**—Over 0.10 to 0.75 per cent. P, 140s. 6d., delivered Birmingham.

**Scotch Iron.**—No. 3 foundry, 124s. 9d.; No. 1 foundry, 127s. 3d., d/d Grangemouth.

**Cylinder and Refined Irons.**—North Zone, 174s.; South Zone, 176s. 6d.

**Refined Malleable.**—North Zone, 184s.; South Zone, 186s. 6d.

**Cold Blast.**—South Staffs, 227s. 6d.

(NOTE.—*Prices of hematite pig-iron, and of foundry and forge iron with a phosphoric content of not less than 0.75 per cent., are subject to a rebate of 5s. per ton.*)

## FERRO-ALLOYS

(*Per ton unless otherwise stated, basis 2-ton lots, d/d Sheffield works.*)

**Ferro-silicon** (5-ton) lots.—25 per cent., £21 5s.; 45/50 per cent., £27 10s.; 75/80 per cent., £43.

**Ferro-vanadium.**—35/50 per cent., 15s. 6d. per lb. of V.

**Ferro-molybdenum.**—70/75 per cent., carbon-free, 6s. per b. of Mo.

**Ferro-titanium.**—20/25 per cent., carbon-free, 1s. 3½d. lb.

**Ferro-tungsten.**—80/85 per cent., 9s. 8d. lb.

**Tungsten Metal Powder.**—98/99 per cent., 9s. 9½d. lb.

**Ferro-chrome.**—4/6 per cent. C, £59; max. 2 per cent. C, 1s. 6d. lb.; max. 1 per cent. C, 1s. 6½d. lb.; max. 0.5 per cent. C, 1s. 6¾d. lb.

**Cobalt.**—98/99 per cent., 8s. 9d. lb.

**Metallic Chromium.**—96/98 per cent., 4s. 5d. lb.

**Ferro-manganese.**—78/98 per cent., £18 10s.

**Metallic Manganese.**—94/96 per cent., carb.-free, 1s. 9d. lb.

## SEMI-FINISHED STEEL

**Re-rolling Billets, Blooms and Slabs.**—BASIC: Soft, u.t., 100-ton lots, £12 5s.; tested, up to 0.25 per cent. C, £12 10s.; hard (0.42 to 0.60 per cent. C), £13 17s. 6d.; silico-manganese, £17 5s.; free-cutting, £14 10s. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £15 15s.; case-hardening, £16 12s. 6d.; silico-manganese, £17 5s.

**Billets, Blooms and Slabs for Forging and Stamping.**—Basic, soft, up to 0.25 per cent. C, £13 17s. 6d.; basic hard, 0.42 to 0.60 per cent. C, £14 10s. 6d.; acid, up to 0.25 per cent. C, £16 5s.

**Sheet and Tinplate Bars.**—£12 2s. 6d., 6-ton lots.

## FINISHED STEEL

[*A rebate of 15s. per ton for steel bars, sections, plates, joists and hoops is obtainable in the home trade under certain conditions.*]

**Plates and Sections.**—Plates, ship (N.-E. Coast), £16 3s.; boiler plates (N.-E. Coast), £17 0s. 6d.; chequer plates (N.-E. Coast), £17 13s.; angles, over 4 un. ins., £15 8s.; tees, over 4 un. ins., £16 8s.; joists, 3 in. × 3 in. and up, £15 8s.

**Bars, Sheets, etc.**—Rounds and squares, 3 in. to 5½ in., £16 18s.; rounds, under 3 in. to ⅜ in. (untested), £17 12s.; flats, over 5 in. wide, £15 13s.; flats, 5 in. wide and under, £17 12s.; rails, heavy, f.o.t., £14 10s. 6d.; hoops, £18 7s.; black sheets, 24 g. (4-ton lots), £22 15s.; galvanised corrugated sheets (4-ton lots), £26 2s. 6d.; galvanised fencing wire, 8g. plain, £26 17s. 6d.

**Tinplates.**—I.C. cokes, 20 × 14 per box, 29s. 9d., f.o.t. makers' works, 30s. 9d., f.o.b.; C.W., 20×14, 27s. 9d., f.o.t., 28s. 6d., f.o.b.

## NON-FERROUS METALS

**Copper.**—Electrolytic, £62; high-grade fire-refined, £61 10s.; fire-refined of not less than 99.7 per cent., £61; ditto, 99.2 per cent., £60 10s.; black hot-rolled wire rods, £65 10s.

**Tin.**—99 to under 99.75 per cent., £275; 99.75 to under 99.9 per cent., £276 10s.; min. 99.9 per cent., £278 10s.

**Spelter.**—G.O.B. (foreign) (duty paid), £25 15s.; ditto (domestic), £26 10s.; "Prime Western," £26 10s.; refined and electrolytic, £27 5s.; not less than 99.99 per cent., £28 15s.

**Lead.**—Good soft pig-lead (foreign) (duty paid), £25; ditto (Empire and domestic), £25; English, £26 10s.

**Zinc Sheets, etc.**—Sheets, 10g. and thicker, ex works, £37 12s. 6d.; rolled zinc (boiler plates), ex works, £35 12s. 6d.; zinc oxide (Red Seal), d/d buyers' premises, £30 10s.

**Other Metals.**—Aluminium, ingots, £110; antimony, English, 99 per cent., £120; quicksilver, ex warehouse, £68 10s. to £69 15s.; nickel, £190 to £195.

**Brass.**—Solid-drawn tubes, 14d. per lb.; brazed tubes, 16d.; rods, drawn, 11¾d.; rods, extruded or rolled, 9d.; sheets to 10 w.g., 10¾d.; wire, 10¾d.; rolled metal, 10¼d.; yellow metal rods, 9d.

**Copper Tubes, etc.**—Solid-drawn tubes, 15¼d. per lb.; brazed tubes, 15¼d.; wire, 10d.

**Phosphor Bronze.**—Strip, 13¾d. per lb.; sheets to 10 w.g., 14¾d.; wire, 16d.; rods, 16d.; tubes, 21¼d.; castings, 19d., delivery 3 cwt. free. 10 per cent. phos. cop. £35 above B.S.; 15 per cent. phos. cop. £43 above B.S.; phosphor tin (5 per cent.) £40 above price of English ingots. (C. CLIFFORD & SON, LIMITED.)

**Nickel Silver, etc.**—Ingots for raising, 10d. to 1s. 4d. per lb.; rolled to 9 in. wide, 1s. 4d. to 1s. 10d.; to 12 in. wide, 1s. 4¼d. to 1s. 10¼d.; to 15 in. wide, 1s. 4¼d. to 1s. 10¼d.; to 18 in. wide, 1s. 5d. to 1s. 11d.; to 21 in. wide, 1s. 5¼d. to 1s. 11¼d.; to 25 in. wide, 1s. 6d. to 2s. Ingots for spoons and forks, 10d. to 1s. 6¼d. Ingots rolled to spoon size, 1s. 1d. to 1s. 9¼d. Wire round, to 10g., 1s. 7¼d. to 2s. 2¼d., with extras according to gauge. Special 5ths quality turning rods in straight lengths, 1s. 6¼d. upwards.

## NON-FERROUS SCRAP

**Controlled Maximum Prices.**—Bright untinned copper wire, in crucible form or in hanks, £57 10s.; No. 1 copper wire, £57; No. 2 copper wire, £55 10s.; copper firebox plates, cut up, £57 10s.; clean untinned copper, cut up, £56 10s.; braziery copper, £53 10s.; Q.F. process and shell-case brass, 70/30 quality, free from primers, £49; clean fired 303 S.A. cartridge cases, £47; 70/30 turnings, clean and baled, £43; brass swarf, clean, free from iron and commercially dry, £34 10s.; new brass rod ends, 60/40 quality, £38 10s.; hot stampings and fuse metal, 60/40 quality, £38 10s.; Admiralty gunmetal, 88-10-2, containing not more than ½ per cent. lead or 3 per cent. zinc, or less than 9½ per cent. tin, £74 10s., all per ton, ex works.

**Returned Process Scrap.**—(Issued by the N.F.M.C. as the basis of settlement for returned process scrap, week ended Oct. 16, where buyer and seller have not mutually agreed a price; net, per ton, ex-sellers' works, suitably packed):—

BRASS.—S.A.A. webbing, £48 10s.; S.A.A. defective cups and cases, £47 10s.; S.A.A. cut-offs and trimmings, £42 10s.; S.A.A. turnings (loose), £37; S.A.A. turnings (baled), £42 10s.; S.A.A. turnings (masticated), £42; Q.F. webbing, £49; defective Q.F. cups and cases, £49; Q.F. cut-offs, £47 10s.; Q.F. turnings, £38; other 70/30 process and manufacturing scrap, £46 10s.; process and manufacturing scrap containing over 62 per cent. and up to 68 per cent. Cu, £43 10s.; ditto, over 58 per cent. to 62 per cent. Cu, £38 10s.; 85/15 gilding metal webbing, £52 10s.; 85/15 gilding defective cups and envelopes before filling, £50 10s.; cap metal webbing, £54 10s.; 90/10 gilding webbing, £53 10s.; 90/10 gilding defective cups and envelopes before filling, £51 10s.

CUPRO NICKEL.—80/20 cupro-nickel webbing, £75 10s., 80/20 defective cups and envelopes before filling, £70 10s.

NICKEL SILVER.—Process and manufacturing scrap: 10 per cent. nickel, £50; 15 per cent. nickel, £56; 18 per cent. nickel, £60; 20 per cent. nickel, £63.

COPPER.—Sheet cuttings and webbing, untinned, £54; shell-band plate scrap, £56 10s.; copper turnings, £48.

## IRON AND STEEL SCRAP

(*Delivered free to consumers' works. Plus 3¾ per cent. dealers' remuneration. 50 tons and upwards over three months, 2s. 6d. extra.*)

**South Wales.**—Short heavy steel, not ex. 24-in. lengths, 82s. to 84s. 6d.; heavy machinery cast iron, 87s.; ordinary heavy cast iron, 82s.; cast-iron railway chairs, 87s.; medium cast iron, 78s. 3d.; light cast iron, 73s. 6d.

**Middlesbrough.**—Short heavy steel, 79s. 9d. to 82s. 3d.; heavy machinery cast iron, 91s. 9d.; ordinary heavy cast iron, 89s. 3d.; cast-iron railway chairs, 89s. 3d.; medium cast iron, 79s. 6d.; light cast iron, 74s. 6d.

**Birmingham District.**—Short heavy steel, 74s. 9d. to 77s. 3d.; heavy machinery cast iron, 92s. 3d.; ordinary heavy cast iron, 87s. 6d.; cast-iron railway chairs, 87s. 6d.; medium cast iron, 80s. 3d.; light cast iron, 75s. 3d.

**Scotland.**—Short heavy steel, 79s. 6d. to 82s.; heavy machinery cast iron, 94s. 3d.; ordinary heavy cast iron, 89s. 3d.; cast-iron railway chairs, 94s. 3d.; medium cast iron, 77s. 3d.; light cast iron, 72s. 3d.

(NOTE.—*For deliveries of cast-iron scrap free to consumers' works in Scotland, the above prices less 3s. per ton, but plus actual cost of transport or 6s. per ton, whichever is the less.*

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## SITUATIONS

FOUNDRY MANAGER (age 38), now free to take up progressive post; iron, non-ferrous and light alloys, mechanised plant, jobbing work; sound practical experience; metallurgical and technical training; M.I.B.F.; any district. —Box 144, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

FOUNDRY MANAGER, M.I.B.F., 48 years, 18 years' full control, practical and technical experience in non-ferrous and all grades of light alloy castings to D.T.D. specification; modern production methods.—Box 140, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

FOUNDRY Superintendent wanted for Glasgow district; sound knowledge of castings for pumps, core making and core blower, and moulding machines; approximate output, 40 tons iron, 30 tons brass weekly.—Write Box No. 153, Room 12, 173, Fleet Street, London, E.C.4.

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BLACKSTONE Diesel Engine-driven Alternator Set, comprising 6-cylinder vertical engine, type E.P.V. 6; 240 h.p.; direct coupled to 200 k.v.a. .8 P.F.; English Electric Alternator, 400 volts, 3-phase, 50 cycles; exciter 600 r.p.m.; Switchboard, Circuit-Breaker and Exciter Panel; equipment: Starting Air Container, two 100-gall. Fuel Tanks, Piping, etc.; Cooling Tower, size 9 ft. sq. by 17 ft.

BLACKSTONE Diesel Engine-driven Alternator Set, comprising 3-cylinder vertical engine, type E.P.V. 3; 120 h.p.; direct coupled to 100 k.v.a. .8 P.F.; English Electric Alternator, 400 volts, 3-phase, 50 cycles; exciter 600 r.p.m.; Switchboard, Circuit-breaker and Exciter Panel; equipment: Ingersoll Rand, type 30; Starting Compressor driven by 2 h.p. Lister petrol engine; Starting Air Container; two 56-gall. Fuel Tanks, Piping, etc.; Cooling Tower, 7 ft. sq. by 15 ft.

INGERSOLL RAND, type XVH-2X, 15 in. by 9 in. by 8 in. stroke Compressor; capacity 670 cub. ft. free air; horizontal h.p. cylinder; vertical l.p. cylinder, intercooler, air receiver. Belt-driven by: BLACKSTONE vertical 4-cylinder, Diesel Engine, 160 h.p., type E.P.V. 4; 600 r.p.m., with extension shaft, outer bearing, belt pulley; P.W. fibre disc friction clutch, circulating pump for compressor belt-driven from extension shaft; Ingersoll Rand Starting Compressor, type 30, driven by 2 h.p. Lister petrol engine; Starting Air Container; two 56-gall. Fuel Tanks, Piping, etc.; Cooling Tower, 6 ft. sq. by 18 ft.

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GENERATOR for Sale (Belliss, Morcom) with Circuit Breaker; in perfect condition; B.H.P. 360, 550 volts, 3-phase, 50 cycles.—Apply ARGUS FOUNDRY, Thornliebank, Glasgow.

FOR SALE.—Four 250-lb. Cumming Furnaces; complete with motors wound 450 a.c.—Offers to Box 160, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

Jackman Whiting Type No. 4 cupola.
Pneulec Royer Sand Thrower; size No. 1; 3/50/400 volts.
Herbert's "Cloudburst" Hardness Testing Machine, by Massey; 3/50/550 volts; 1,430 r.p.m.
Morgan Type "S" Oil-fired Tilting Furnace; 400-440 lbs. capacity.
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Silkysand Disintegrator.
Sand Mills; 5 ft., 4 ft. 6 in., and 5 ft. 6 in.

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## MISCELLANEOUS

BRASS FOUNDRY FOR SALE. OLD ESTABLISHED. NEAR MANCHESTER. PRINCIPALS ONLY.—Box 152, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

SANDBLASTING SAND.—Quotations wanted for weekly delivery.—Please reply to Box 156, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

BRASS SCREWS wanted; as used for oddsiding patterns in Ironfoundry.—Please reply to Box 158, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

WARWILL have capacity in 12/14 weeks' time for Non-Ferrous Castings up to 1 cwt. Also in 4/5 weeks' time in Grey Iron up to 1 ton; inquiries should receive prompt attention.—WARWILL, LTD., Abertillery. 'Phone 71.

FOR SALE.—Foundry Core-Drying Plates (Steel); holeless 5- or 6-gauge thick; width 10½ in.; any length up to 50 in.; price 12s. 6d. per cwt. f.o.r.—TIPTON COAL & IRON CO., Tipton.

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# FOUNDRY TRADE JOURNAL

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